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EXAMINER

BOOKER, VICKI B

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/596,726	Applicant(s) YANSON ET AL.	
	Examiner VICKI B. BOOKER	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 April 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 - 29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 - 29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 June 2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>See Continuation Sheet</u> . | 6) <input type="checkbox"/> Other: _____ |

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :31 October 2006 and 04 April 2007 and 04 April 2007 and 25 April 2007.

DETAILED ACTION

This Office Action is in response to the restriction election filed April 9, 2009. Currently, **Claims 1 – 29** are pending.

Election/Restrictions

Applicant's election of Invention Group I, **Claims 1 – 29** in the reply filed on April 9, 2009 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claims 30 – 34 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Priority

Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

The information disclosure statement (IDS) filed April 4, 2007 fails to comply with 37 CFR 1.98(a)(3) because it does not include a concise explanation of the relevance, as it is presently understood by the individual designated in 37 CFR 1.56(c) most

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knowledgeable about the content of the information, of each foreign patent and non-patent literature document listed that is not in the English language.

Examiner notes foreign patent document KR 0044158 does not include an English abstract. Examiner further notes a concise explanation of the relevance of this foreign patent **is not** included in the specification.

Examiner notes non-patent literature document Yi, H. et al. does not include an English abstract or translation explaining its relevance.

The IDS has been placed in the application file. However, the references noted above that are not in conformance have **not** been considered.

Specification

The disclosure is objected to because of the following informalities:

The specification does not include headings or subheadings to denote sections as noted in 37 CFR 1.77(b).

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, ***as a section heading***. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

- (a) TITLE OF THE INVENTION.
- (b) CROSS-REFERENCE TO RELATED APPLICATIONS.
- (c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.

- (d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
- (e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
- (f) BACKGROUND OF THE INVENTION.
 - (1) Field of the Invention.
 - (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (g) BRIEF SUMMARY OF THE INVENTION.
- (h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
- (i) DETAILED DESCRIPTION OF THE INVENTION.
- (j) CLAIM OR CLAIMS (commencing on a separate sheet).
- (k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
- (l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

Further guidance on the relevant content for each section is provided below:

Content of Specification

- (a) Title of the Invention: See 37 CFR 1.72(a) and MPEP § 606. The title of the invention should be placed at the top of the first page of the specification unless the title is provided in an application data sheet. The title of the invention should be brief but technically accurate and descriptive, preferably from two to seven words may not contain more than 500 characters.
- (b) Cross-References to Related Applications: See 37 CFR 1.78 and MPEP § 201.11.
- (c) Statement Regarding Federally Sponsored Research and Development: See MPEP § 310.
- (d) The Names Of The Parties To A Joint Research Agreement: See 37 CFR 1.71(g).

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- (e) Incorporation-By-Reference Of Material Submitted On a Compact Disc: The specification is required to include an incorporation-by-reference of electronic documents that are to become part of the permanent United States Patent and Trademark Office records in the file of a patent application. See 37 CFR 1.52(e) and MPEP § 608.05. Computer program listings (37 CFR 1.96(c)), "Sequence Listings" (37 CFR 1.821(c)), and tables having more than 50 pages of text were permitted as electronic documents on compact discs beginning on September 8, 2000.
- (f) Background of the Invention: See MPEP § 608.01(c). The specification should set forth the Background of the Invention in two parts:
 - (1) Field of the Invention: A statement of the field of art to which the invention pertains. This statement may include a paraphrasing of the applicable U.S. patent classification definitions of the subject matter of the claimed invention. This item may also be titled "Technical Field."
 - (2) Description of the Related Art including information disclosed under 37 CFR 1.97 and 37 CFR 1.98: A description of the related art known to the applicant and including, if applicable, references to specific related art and problems involved in the prior art which are solved by the applicant's invention. This item may also be titled "Background Art."
- (g) Brief Summary of the Invention: See MPEP § 608.01(d). A brief summary or general statement of the invention as set forth in 37 CFR 1.73. The summary is separate and distinct from the abstract and is directed toward the invention rather than the disclosure as a whole. The summary may point out the advantages of the invention or how it solves problems previously existent in the prior art (and preferably indicated in the Background of the Invention). In chemical cases it should point out in general terms the utility of the invention. If possible, the nature and gist of the invention or the inventive concept should be set forth. Objects of the invention should be treated briefly and only to the extent that they contribute to an understanding of the invention.
- (h) Brief Description of the Several Views of the Drawing(s): See MPEP § 608.01(f). A reference to and brief description of the drawing(s) as set forth in 37 CFR 1.74.

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- (i) Detailed Description of the Invention: See MPEP § 608.01(g). A description of the preferred embodiment(s) of the invention as required in 37 CFR 1.71. The description should be as short and specific as is necessary to describe the invention adequately and accurately. Where elements or groups of elements, compounds, and processes, which are conventional and generally widely known in the field of the invention described and their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, they should not be described in detail. However, where particularly complicated subject matter is involved or where the elements, compounds, or processes may not be commonly or widely known in the field, the specification should refer to another patent or readily available publication which adequately describes the subject matter.
- (j) Claim or Claims: See 37 CFR 1.75 and MPEP § 608.01(m). The claim or claims must commence on separate sheet or electronic page (37 CFR 1.52(b)(3)). Where a claim sets forth a plurality of elements or steps, each element or step of the claim should be separated by a line indentation. There may be plural indentations to further segregate subcombinations or related steps. See 37 CFR 1.75 and MPEP § 608.01(i)-(p).
- (k) Abstract of the Disclosure: See MPEP § 608.01(f). A brief narrative of the disclosure as a whole in a single paragraph of 150 words or less commencing on a separate sheet following the claims. In an international application which has entered the national stage (37 CFR 1.491(b)), the applicant need not submit an abstract commencing on a separate sheet if an abstract was published with the international application under PCT Article 21. The abstract that appears on the cover page of the pamphlet published by the International Bureau (IB) of the World Intellectual Property Organization (WIPO) is the abstract that will be used by the USPTO. See MPEP § 1893.03(e).
- (l) Sequence Listing. See 37 CFR 1.821-1.825 and MPEP §§ 2421-2431. The requirement for a sequence listing applies to all sequences disclosed in a given application, whether the sequences are claimed or not. See MPEP § 2421.02.

Appropriate correction is required. Any amendment of the Specification must be in compliance with 37 CFR § 1.121. Applicant should also be careful not to introduce

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any new matter into the disclosure (i.e., matter which is not supported by the disclosure as originally filed). See MPEP § 706.03(o).

Drawings

The drawings are objected to for the following informalities:

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4)

because reference characters "20" and "54" have both been used to designate the same layer in FIG. 2-6. In addition, reference character "20" used in FIG. 2-10 and FIG. 2-11, and reference character "20, 54" used in FIG. 2-9 have both been used to designate the same layer.

For clarity and consistency of nomenclature, it is recommended the reference character "20" in FIG. 2-6 be changed to "20, 54" and the reference character "54" be removed; and the reference character "20" in FIG. 2-10 and FIG. 2-11 be changed to reference character "20,54", respectively.

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5)

because they include the following reference character(s) not mentioned in the description: "2...5" as noted in FIG. 2.

Correction to the drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add or remove the reference character(s) in the description in compliance with 37 CFR 1.121(b), is required in reply to the Office Action to avoid abandonment of the application. Any amended replacement drawing sheet

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should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended.

If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures.

Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

In addition to Replacement Sheets containing the corrected drawing figure(s), applicant is **required** to submit a marked-up copy of each Replacement Sheet including annotations indicating the changes made to the previous version. The marked-up copy must be clearly labeled as "Annotated Sheets" **and must be presented in the amendment or remarks section** that explains the change(s) to the drawings. See 37 CFR 1.121(d)(1). Failure to timely submit the proposed drawing and marked-up copy will result in the abandonment of the application.

Appropriate correction is required (See also MPEP §608.02).

Claim Objections

Claims 18 – 20 and **29** are objected to because of the following informalities:

Claim 18 recites “the step of planarizing the substrate after the applying the intermixing agent”. It is recommended this be changed to “a step of planarizing the substrate after the step of applying the intermixing agent” for clarity and consistency in proper antecedent basis.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 7 – 9, 11, 15, and 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Teng et al. (WO 03/085742; published 10/16/2003; hereinafter “TENG ‘742”).

Regarding **Claim 1**, TENG ‘742 disclose a method for producing multiple quantum well intermixed (QWI) regions having different bandgaps on a single substrate (“Method for Forming A Modified Semiconductor Having A Plurality of Band Gaps”; See Abstract), comprising the steps of:

forming a substrate 1 comprising one or more core layers defining at least one quantum well 4 (See, for example, “Third Preferred

Embodiment” shown as a flowchart in FIG. 4 and FIG. 6A – FIG. 6H; Page 12, line 15 through Page 14, line 4);

depositing a succession of intermixing barrier layers 8, 9 over the quantum well 4, each successive intermixing barrier layer 8, 9 being formed of a semiconductor material (Page 3, line 29 through Page 4, line 5; “low temperature deposited InP” or “low temperature deposited InGaAs or GaAs”) and having a different etch characteristic than an immediately preceding barrier layer (Examiner notes an etch characteristic is an inherent physical property of a material; Therefore the different materials 9, 10 shown in FIG. 6A - FIG. 6H inherently have different etch characteristics);

etching away (Page 4, line 13 – 14; “photolithography”; Fig. 4, Step 6; “patterning layer”) different numbers of the successive barrier layers 8, 9 in different regions F, G of the substrate 1 (FIG. 6A – FIG. 6H; Page 12, line 15 – Page 14, line 4) so as to provide different total thicknesses of barrier layer in different regions F, G of the substrate 1; and

applying an intermixing agent (“annealing”; FIG. 4, Step 7; Page 13, line 27 – 31) to the surface of the substrate 1 such that the degree of intermixing in the quantum well region varies as a function of the total thickness of barrier layer, thereby forming different bandgaps in the quantum well in each of the respective regions (“thermally annealing 7 the heterostructure to cause intermixing in the quantum region thereby

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producing a semiconductor heterostructure with a surface having particular regions which exhibit different band gap shifts depending on which combination of materials they were covered by”; Page 13, line 27 – 31).

Regarding **Claim 2**, TENG '742 disclose the method of **Claim 1** in which the step of depositing the intermixing barrier layers 8, 9 comprises epitaxial growth (“molecular beam epitaxy (MBE)”; Page 4, line 7; Page 10, line 20).

Regarding **Claim 7** and **Claim 8**, TENG '742 disclose the method of **Claim 1** further including the step of activating the intermixing agent (“annealing causes intermixing”; Page 10, line 27; **Claim 7**) and further wherein the step of activating the intermixing agent comprises thermally processing the substrate after delivering the intermixing agent to the substrate (Fig. 4, Step 7, “Annealing”; Page 13, line 27 – 31; “thermally annealing 7 the heterostructure to cause intermixing in the quantum region”; **Claim 8**).

Regarding **Claim 9**, TENG '742 disclose the method of **Claim 1** in which the barrier layers 8, 9 alternate between two different material types (Page 10, line 8 – 10).

Regarding **Claim 11** and **Claim 15**, TENG '742 disclose the method of **Claim 1**, respectively, in which the quantum well region 4 is formed from an aluminium

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quaternary indium phosphide material ("InGaAlAs"; Page 6, line 3; **Claim 11**) or an aluminium ternary gallium arsenide material ("AlGaAs"; Page 6, line 1; **Claim 15**).

Regarding **Claim 21**, TENG '742 disclose the method of **Claim 1** in which the step of depositing the succession of intermixing barrier layers comprises:

depositing a first intermixing barrier layer 8 onto the substrate 1 over said quantum well region 4, the first barrier layer 8 being formed of a semiconductor material (Page 10, line 1 – 10) having a first etch characteristic (FIG. 6A; Examiner notes an etch characteristic is an inherent material property);

depositing a second intermixing barrier layer 9 onto the substrate 1 over said first barrier layer 8, the second barrier layer 9 being formed of a semiconductor material (Page 10, line 1 – 10) having a second etch characteristic (FIG. 6E); and

etching away the first 8 and second 9 barrier layers in first regions F of the substrate 1 (FIG. 6E – FIG. 6F) and etching away the second barrier layer 9 in second regions G of the substrate 1 (FIG. 6F) and leaving the first and second barrier layers 8, 9 in other regions J of the substrate 1 (FIG. 6G);

such that after applying the intermixing agent ("annealing"; FIG. 4, Step 7) to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in each of the first regions F, the

second regions G and the other regions J (Page 13, line 27 – Page 14, line 4).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3, 12, 16, 18 – 20, 22 – 24, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742.

Regarding **Claims 3, 12, 16, and 24**; and **Claims 22 – 23**; TENG '742 disclose the method of **Claim 1** and **Claim 21**, respectively, as noted above.

Regarding the further limitations of Claim 1 in which

the intermixing barrier layers each comprise substantially single crystal semiconductor layers (**Claim 3**);

or in which

the intermixing barrier layers include successive layers of indium phosphide (InP) and indium gallium arsenide (InGaAs) (**Claim 12**);

or in which

the intermixing barrier layers include successive layers of gallium arsenide (GaAs), aluminium gallium arsenide (AlGaAs) or aluminium arsenide (AlAs) (**Claim 16**) –

or in which

the step of depositing the succession of intermixing barrier layers
comprises:

depositing a first and second intermixing barrier layers
onto the substrate over said quantum well region, the first
and second barrier layers being formed of semiconductor
material and respectively having first and second etch
characteristics;

depositing a third and fourth intermixing barrier layers
onto the substrate over said first and second barrier layers,
the third and fourth barrier layers being formed of
semiconductor material and respectively having third and
fourth etch characteristics;

etching away the first, second, third and fourth barrier
layers in first regions of the substrate and etching away the
third and fourth barrier layers in second regions of the
substrate and leaving the first, second, third and fourth
barrier layers in other regions of the substrate;

such that after applying the intermixing agent to the
surface of the substrate, different bandgaps in the quantum
well region are respectively formed in the first regions, the
second regions and the other regions (**Claim 24**);

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and regarding the further limitations of Claim 21 in which

the step of depositing further includes

depositing a third intermixing barrier layer onto the substrate prior to depositing the first and second barrier layers, the third barrier layer being formed of a semiconductor material having a third etch characteristic; and

in which the etching step includes etching away the first, second and third barrier layers in third regions of the substrate; such that after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in each of the first regions, the second regions, the third regions and the other regions (**Claim 22**); ***and still further in which***

the third etch characteristic is the same as the second etch characteristic (**Claim 23**) –

Examiner notes the following teachings of TENG '742:

TENG '742 teach a large variety of band gap shifts can be achieved ***in different regions of the same substrate*** by combining two, three, four, or more layers of different materials in succession and applying them in different coverage ratios by patterning the layers in different ways on the substrate and over the quantum well region of the substrate (Page 14, lines 5 – 10; See also Abstract).

TENG '742 teach the patterning of the intermixing barrier layers can be by photolithography (Page 4, line 14) – which Examiner notes is a patterning technique that comprises etching (MPEP § 2144.03).

TENG '742 provides some specific examples in FIG. 7 – FIG. 10 of the different band gap shifts that can be achieved using different materials, different annealing processes, and different pattern coverage ratios.

TENG '742 thereby teach the number of intermixing barrier layers formed on the surface of the substrate; the choice of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate surface; are **results-effective variables** used to achieve different bandgaps in different regions of the same substrate (MPEP § 2144.05 Section II. B.)

Therefore, it would have been obvious for one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claims 3, 12, 16, and 22 – 24**, based on the teachings of TENG '742 as noted above.

The motivation for doing so would have been to optimize the number of intermixing barrier layers formed on the surface of the substrate; the type of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate – ***through routine experimentation*** – such that, after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in the

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first regions, the second regions and the other regions of the substrate – **as desired by design choice** (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

A prima facie case of obviousness thereby exists for **Claims 3, 12, 16, and 22 – 24 (MPEP § 2142)**.

Regarding **Claim 18**, TENG '742 disclose the method of **Claim 1** as noted above. **Regarding the limitation of** further comprising the step of planarizing the substrate after the applying the intermixing agent, Examiner will interpret "planarizing the substrate" as removing all or part of a layer -- based on the use of "planarizing" in the specification as noted for FIG. 1-9 – FIG. 1-12 and described on Page 10, lines 1 – 13 of the specification.

TENG '742 teaches planarizing the substrate 1 after applying the intermixing agent 8 (FIG. 6A - FIG. 6B).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 18**, based on the teachings of TENG '742.

The motivation for doing so, at the time of the invention, would have been to pattern the surface of the substrate, as desired, to form multiple quantum well intermixed regions having different bandgaps on a single substrate, as taught by TENG '742 (Page 14, line 5 – 10). A prima facie case of obviousness thereby exists for **Claim 18** (See MPEP § 2142).

Regarding **Claim 29**, TENG '742 teach or disclose the method of **Claim 18** as noted above. ***Regarding the further limitation of still further including the steps of:***

depositing a succession of planarization layers beneath the succession of intermixing barrier layers, the succession of planarization layers identical in number of layers and layer materials to the first succession of barrier layers, but having a total thickness substantially less than the total thickness of the first succession of intermixing barrier layers; planarizing the substrate by successively removing intermixing barrier layers and corresponding planarization layers in a series of selective etches –

Examiner notes the following teachings of TENG '742:

TENG '742 teach a large variety of band gap shifts can be achieved by combining two, three, four, or more layers of different materials in succession and applying them in different coverage ratios by patterning the layers in different ways on the substrate and over the quantum well region (Page 14, lines 5 – 10).

TENG '742 teach the patterning of the intermixing barrier layers can be by photolithography (Page 4, line 14) – which Examiner notes is a patterning technique that comprises etching (MPEP § 2144.03).

TENG '742 provides some specific examples in FIG. 7 – FIG. 10 of the different band gap shifts that can be achieved using different materials, different annealing processes, and different pattern coverage ratios.

Therefore, TENG '742 teach the number of intermixing barrier layers formed on the surface of the substrate; the choice of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate surface; are **results-effective variables** used to achieve different bandgaps in different regions of the same substrate (MPEP § 2144.05 Section II. B.)

Therefore, it would have been obvious for one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 29** based on the teachings of TENG '742 as noted above.

The motivation for doing so would have been to optimize the number of intermixing barrier layers formed on the surface of the substrate; the type of material selected for each intermixing barrier layer; the pattern of each intermixing barrier layer; and the coverage ratio of the resulting patterns over the substrate – ***through routine experimentation*** – such that, after applying the intermixing agent to the surface of the substrate, different bandgaps in the quantum well region are respectively formed in the first regions, the second regions and the other regions of the substrate – **as desired by design choice** (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)). A prima facie case of obviousness thereby exists for **Claim 29** (MPEP § 2142).

Regarding **Claim 19**, TENG '742 teach or disclose the method of **Claim 18** as noted above, in which the planarizing step comprises removing one or more of the

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intermixing barrier layers from the surface of the substrate (TENG '742; FIG. 6A – FIG. 6B).

Regarding **Claim 20**, TENG '742 teach or disclose the method of **Claim 19** as noted above, in which the planarizing step comprises removing all of the intermixing barrier layers from the surface of the substrate (Since TENG '742 teach the pattern of the intermixing barrier layers is a results-effective variable, effecting the value of the band-gap shift in the substrate – See TENG '742 teachings as noted for **Claim 29** above – removing all of the intermixing barrier layers from the surface of the substrate would be a matter of design choice in order to pattern the surface of the substrate, as desired, to achieve a desired band gap shift in the substrate; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Claims 5, 6, 10, 25, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of Applicant's Admitted Prior Art (hereinafter "APA").

Examiner notes subsequent reference to APA is made using Applicant's specification as published (US 2007/0246701 A1; published 10/25/2007). See MPEP § 2129 Section I and II.

Regarding **Claim 5**, TENG '742 in view of APA teach or disclose the method of **Claim 1** in which the step of applying an intermixing agent to the surface of the substrate comprises bombarding the substrate with high energy ions in an ion

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implantation process (APA, Para [0011] teaches it is commonly known in the art to use ions as an intermixing agent by directing an ion beam at the material being intermixed; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 6**, TENG '742 in view of APA teach or disclose the method of **Claim 1** in which the step of applying an intermixing agent to the surface of the substrate comprises depositing a QWI cap layer onto the substrate, the QWI cap layer initiating or promoting intermixing (APA Para [0011] teaches it is commonly known in the art to apply an intermixing agent in the form of a QWI cap layer ("dielectric cap") to initiate or promote intermixing; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 10**, TENG '742 in view of APA teach or disclose the method of **Claim 1** in which the barrier layers are grouped in pairs, each of the respective regions having a different number of pairs of barrier layers (APA teaches it is commonly known in the art to use the thickness of a barrier layer to control the rate of intermixing; The barrier layer thickness is thereby a results-effective variable; See Para [0011]; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 25**, TENG '742 in view of APA teach or disclose the method of **Claim 6** in which the QWI cap layer comprises an impurity rich material (APA, Para [0011], "intermixing agent may be in the form of a dielectric cap containing an impurity

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source”; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Regarding **Claim 28**, TENG ‘742 in view of APA teach or disclose the method of **Claim 6** in which the QWI cap layer is sputter deposited (Examiner notes sputter-depositing a layer is commonly known in the art as an effective means to deposit a layer; MPEP § 2144.03; A prima facie case of obviousness thereby exists for this limitation; MPEP § 2142).

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG ‘742 in view of Fu et al. (US 2004/0038503; published 02/26/2004; hereinafter “FU”).

Regarding **Claim 4**, TENG ‘742 disclose the method of **Claim 1** as noted above.

TENG ‘742 do not disclose further in which the steps of forming the substrate **and** depositing the intermixing barrier layers are carried out in the same epitaxial growth equipment.

Examiner notes TENG ‘742 teach depositing the intermixing barrier layers in epitaxial growth equipment (“MBE”; Page 10, line 20) and that the substrate 1 is a heterostructure substrate (Page 8, line 16 – 21; Page 12, line 25 – 27).

FU teach a heterostructure substrate can be formed in epitaxial growth equipment (“MBE”; Paragraph [0002]).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG ‘742 to obtain the invention of **Claim 4**.

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The motivation for doing so, at the time of the invention, would have been an obvious matter of equipment cost savings by carrying out the step of forming the substrate and the step so depositing the intermixing barrier layers in the same epitaxial growth equipment since FU teaches MBE can be used to form a heterostructure substrate, and TENG '742 teach use of MBE to form the intermixing barrier layers. A prima facie case of obviousness thereby exists for **Claim 4** (MPEP § 2142).

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of Pommereau et al. (US 6,309,904; dated 10/30/2001; hereinafter "POMMEREAU") and further in view of Kinoshita et al. (US 5,021,361; dated 06/04/1991; hereinafter "KINOSHITA").

Regarding **Claim 13**, TENG '742 teach or disclose the method of **Claim 12** as noted above.

Regarding the further limitation in which the etching step comprises etching the InGaAs layers in $H_3PO_4:H_2O_2:H_2O$ and etching the InP layers in $HCl:H_2O$ –

POMMEREAU teach $H_3PO_4:H_2O_2:H_2O$ as suitable for etching InGaAs layers (Column 6, line 59 – 61).

KINOSHITA teach $HCl:H_2O$ ("hydrochloric acid solution"; Column 7, line 67 – 68) as suitable for etching InP layers.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 13**, based

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on the teachings of POMMEREAU and KINOSHITA, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the InGaAs layers and the InP layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416).

A prima facie case of obviousness thereby exists for **Claim 13** (See MPEP § 2142).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of POMMEREAU, and further in view of Cheng et al. (US 4,829,347; dated 05/9/1989; hereinafter "CHENG").

Regarding **Claim 14**, TENG '742 teach or disclose the method of **Claim 12** as noted above.

Regarding the further limitation in which the etching step comprises etching the InGaAs layers in $H_2SO_4:H_2O_2:H_2O$ and etching the InP layers in $HCl:H_3PO_4$ —

POMMEREAU teach $H_2SO_4:H_2O_2:H_2O$ as suitable for etching InGaAs layers (Column 6, line 59 – 62).

CHENG teach $HCl:H_3PO_4$ as suitable for etching InP layers (Column 6, line 57 – 58).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 13**, based on the teachings of POMMEREAU and CHENG, since it has been held that mere

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selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the InGaAs layers and the InP layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416).

A prima facie case of obviousness thereby exists for **Claim 14** (See MPEP § 2142).

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of Bayraktaroglu (US 5,283,448; dated 02/01/1994; hereinafter "BAYRAKTAROGLU") and further in view of Kasahara et al. (US 5,527,732; dated 06/18/1996; hereinafter "KASAHARA").

Regarding **Claim 17**, TENG '742 teach or disclose the method of **Claim 16** as noted above.

Regarding the further limitation in which the etching step comprises etching the GaAs layers in H₂SO₄:H₂O₂:H₂O and etching the AlGaAs/AlAs layers in a buffered HF solution –

BAYRAKTAROGLU teach H₂SO₄:H₂O₂:H₂O as suitable for etching GaAs layers (Column 2, line 22 – 23).

KASAHARA teach a buffered HF solution as suitable for etching AlGaAs/AlAs layers (Column 6, line 54 – 57; FIG. 3).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 to obtain the invention of **Claim 17**, based on the teachings of BAYRAKTAROGLU and KASAHARA, since it has been held that

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mere selection of a material suitable for an intended use, which in the instant case is selection of suitable etchants for the GaAs layers and the AlGaAs/AlAs layers, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416).

A prima facie case of obviousness thereby exists for **Claim 17** (See MPEP § 2142).

Claims 26 – 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over TENG '742 in view of APA, further in view of Thornton et al. (US 4,875,216; dated 10/17/1989; hereinafter "THORNTON").

Regarding **Claim 26** and **Claim 27**, TENG '742 in view of APA teach or disclose the method of **Claim 25** as noted above.

Regarding the further limitation in which

the impurity comprises one or more of sulphur, zinc, silicon,
fluorine, copper, germanium, tin and selenium (Claim 26);

or in which, for the method of Claim 25 or Claim 26,

the impurity-rich material comprises silica doped with one or more
of the impurities sulphur, zinc, silicon, fluorine, copper,
germanium, tin and selenium –

Examiner notes the following teachings of THORNTON:

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THORNTON teaches a QWI cap layer initiating or promoting intermixing ("impurity induced disordering (IID)") that comprises impurities such as silicon, zinc, tin, germanium, sulfur, or other impurity species (Column 5, line 17 – 19).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the invention, to modify TENG '742 in view of APA to obtain the invention of **Claim 26** and **Claim 27**, based on the teachings of THORNTON.

The motivation for doing so, at the time of the invention, would have been to select suitable impurity species for the QWI cap layer, since it has been held that mere selection of a material suitable for an intended use, which in the instant case is selection of suitable impurity species for the QWI cap layer, is a matter of obvious design choice when such suitability is known in the art (*In re Leshin*, 125 USPQ 416). A prima facie case of obviousness thereby exists for **Claim 26** and **Claim 27** (MPEP § 2142).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vicki B. Booker whose telephone number is 571-270-1565. The examiner can normally be reached Monday through Thursday 9:30am to 6pm E.S.T. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew C. Landau can be reached on 571-272-1731. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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